Greetings and welcome to the **APRIL 2016** edition of the WDFW Climate News Digest. Our goal is to provide highlights of relevant climate change news, events and resources for WDFW staff. Feedback or suggestions for items to include in future editions are much appreciated – *thanks* to those who have sent links and references and please keep them coming.

Thanks for contributions this month from, Bob Vadas, Wendy Connally, Dan Siemann (DNR), Joe Buchanan, David Howe, Derek Stinson, Bruce Botka, Teresa Scott and Jim Scott. Other sources for news include: Point Blue Conservation Science, NPLCC Climate Science Digest, Climate.gov, NOAA.gov, DNR's eMission Control, NOAA Climate Newsletter, and "BioClimate", the newsletter of the USGS Climate Science Centers. Contact Lynn for information about subscribe directly to any of these.

WHAT'S HAPPENING AT WDFW?

Using Climate Resilience to site Wild Steelhead Gene Banks

WDFW is in the process of identifying Wild Steelhead Gene Banks (WSGBs) throughout Washington as a component of our strategy to conserve and recover wild steelhead. Our intent is to select populations that will be strong contributors to the long-term conservation and recovery of wild steelhead. To achieve this, our guidance for selecting WSGBs identifies an ideal candidate population as: 1) not substantially affected by historical hatchery programs; 2) a valuable contributor to the regional diversity of steelhead populations; 3) abundant and productive; and 4) self-sustaining in the future. Climate change can have a substantive effect on whether a steelhead population will be self-sustaining in the future. While we expect that some adaptation will occur, we can be more confident that wild steelhead populations will persist in the long-term in rivers with significant portions of the watershed in high elevation areas. For this reason , future climate change, basin characteristics, and hydrographic type became important considerations in the identification of WSGBs in the Puget Sound area. As an example, the Elwha River is a good candidate for a WSGB for many reasons, but among them is that the average watershed elevation is the fifth highest of all Puget Sound steelhead populations (1021M), and it has a snow dominated (39%) hydrographic type, with an anticipation of suitable habitat conditions existing in the future. Resilience to climate impacts isn't the only determinant of our selection of WSGBs – but it is an important one.
For more information contact Jim Scott, Special Assistant to the Director

CLIMATE ADAPTATION AT OTHER ORGANIZATIONS

California Natural Resources Agency

The California Natural Resources Agency recently released Safeguarding California: Implementation Action Plans, a document that shows how state government is acting to convert the recommendations from the 2014 Safeguarding California: Reducing Climate Risk report into action.

Center for Disease Control and Prevention – Climate and Health Program
(Note: see April 26th webinar under Learning Opportunities – the Washington State Department of Health is hosting a conversation with George Luber, Chief of the Climate and Health Program)
While climate change is a global issue, the effects of climate change will vary across geographic regions and populations - CDC's Climate and Health Program is helping state and city health departments prepare for the specific health impacts of climate change that their communities will face.
More »

RESOURCES

2015 Drought Response – Summary Report *(from Department of Ecology)*

A review of 2015 drought impacts brought some surprising insights. While surface water creeks and rivers have bounced back so far this winter, an overall decline in groundwater is being seen even in good water years as detailed in a special groundwater story map report . Unlike classic droughts, characterized by extended precipitation deficits, 2015 was the year of the "snowpack drought." Washington State had normal or near-normal precipitation over the 2014-2015 winter season. However, October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the 20th century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain.

Fish and wildlife impacts (excerpt from the report)

The drought was directly responsible for widespread fish die-offs, and impacts to wildlife. Hundreds of thousands of Columbia/Snake River Basin sockeye salmon perished in July. There was confirmed mortality of 182 sturgeon, most were large, breeding sized fish, in the Columbia River. Widespread reports of fish strandings occurred throughout the state, including federally-listed species such as bull trout. Also, more than 1.5 million juvenile salmon, steelhead, and rainbow trout died at 11 Washington hatcheries due to drought conditions.

Climate Shield: Cold-water Refuge Streams for native trout *(from USFS Rocky Mountain Research Station)*

The Climate Shield website hosts geospatial data and related information that describes specific locations of cold-water refuge streams for native Cutthroat Trout and Bull Trout across the northwestern U.S. Populations of many cold-water species are likely to decline this century with global warming, but declines will vary spatially and some populations will persist even under extreme climate change scenarios. Especially cold habitats could provide important refugia from both future environmental change and invasions by non-native species that prefer warmer waters. Forecasts about the locations of refugia could enable the protection of key watersheds, be used to rally support among multiple stakeholders, and provide a foundation for planning climate-smart conservation networks that improve the odds of preserving native trout populations through the 21st century.

The Essential Principles of Climate Literacy *(from Climate.gov)*

Climate and energy are complex topics. There are many ways to approach climate and energy depending on the grade level, course topics and instructional method. **Learn more...**

Water Resources Dashboard: A one-stop site for water-related data and information *(from NOAA and Climate.gov)*

This new tool is designed to help communities become more resilient to water hazards and threats. All regions and economic sectors in the United States depend on adequate and reliable water supplies. Too much or too little water can endanger the health and welfare of citizens and businesses. Driven by feedback from water resource managers, federal agencies and others, NOAA and partners have developed the Water Resources Dashboard: a one-stop website for relevant water data on drought, flooding, precipitation, climate and other measures.

Climate Change Indicators *(from EPA)*

EPA partners with over 40 data contributors from various government agencies, academic institutions, and other organizations to compile and communicate key indicators related to the causes and effects of climate change. The 30 indicators presented here are published in EPA's *Climate Change Indicators in the United States* report.

Explore this website or download the latest report to learn more about the changes we are seeing now. Indicators are updated periodically on the Web as newer data become available. For additional information about EPA's climate change indicators, see Frequent Questions.

Climate Data Primer (*from Climate.gov)*
Ready to learn some of the basics about climate data? Find out about measuring, modeling, and predicting climate and ways to find and use climate data with Climate.gov's Climate Data Primer.

National Ecological Observatory Network (NEON) -- **Project BudBurst**
Through Project BudBurst, citizen scientists are collecting valuable information about seasonal plant cycles in a consistent way across the country. Scientists use the data to learn more about the responsiveness of individual plant species to changes in climate locally, regionally and nationally.
Learn more...

LEARNING OPPORTUNITIES

April 14th, 10:00-11:00 am (Pacific), webinar, " Utilizing the US Climate Resilience Toolkit", sponsored by the Association of Climate Change Officers (ACCO). The Climate Resilience Toolkit provides scientific tools, information, and expertise to help professionals manage their climate-related risks and opportunities, and improve their resilience to extreme events. This interactive webinar will provide background on the Toolkit and lead participants through an activity to demonstrate ways in which they can harness this outstanding resource. Speakers include David Herring (NOAA - Director of Communications and Engagement), and Phil Santiago (Association of Climate Change Officers - Senior Program Manager).
Register here.

April 14th, 11: 00 am (Pacific), webinar, "Sharing the Balance of Stewardship: the Blackfoot Drought Response Plan", hosted by the Great Northern LCC Rocky Mountain Partner Forum. In Western Montana's Blackfoot Watershed, diverse watershed stakeholders have been working collaboratively for 20 years to share the burden of low water years, but also the benefits of a coordinated water conservation and stewardship strategy. This webinar will illustrate how the Blackfoot Drought Response Plan works and how it has evolved recently in response to persistent drought, changing watershed priorities, and a new tribal water compact.
Register here.

April 26th, 12:00 pm (Pacific), webinar, the Washington State Department of Health will be hosting a webinar presentation, **"Under the Weather: The Health Consequences of a Changing Climate"** by George Luber, PhD, Chief of the Climate and Health Program at the Centers for Disease Control and Prevention. Registration for this webinar will be available soon. Please contact Marnie.Boardman@doh.wa.gov if interested.
In addition to managing the Climate Change Program at CDC, Dr. Luber is a Co-Chair of the Climate Change and Human Health Interagency Workgroup at the US Global Change Research Program, a Convening Lead Author for the US National Climate Assessment, a member of the American Anthropological Association's Presidential Task Force on Climate Change, and a lead author for the Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report. He is also Adjunct Professor in the Departments of Environmental Health, Anthropology, and Environmental Science at Emory University.

April 26, Workshop: "Introducing the Southwest Washington Climate Change Vulnerability Assessment", Vancouver, WA

The purpose of this workshop is to inform climate change adaptation planning on the Gifford Pinchot National Forest. RSVP: Please notify Jessica Hudec (jhudec@fs.fed.us or 509-395-3403) if you plan to attend so we can be sure to reserve an appropriately sized meeting space.

April 27, 10 am, (Pacific), webinar, "The Climate Change Vulnerability Assessment Tool for Coastal Habitats"
The Climate Change Vulnerability Assessment Tool for Coastal Habitats (CCVATCH) is a spreadsheet-based decision support tool that utilizes a team of local experts — land managers and researchers — to assess the possible interactions of climate change, stressors, and adaptive capacity to understand the climate vulnerabilities of a habitat. The spreadsheet calculates scores for sensitivity-exposure, adaptive capacity, and overall vulnerability. Learn more at http://www.ccvatch.com.

July 11-15, 2016, Training, National Conservation Training Center, Shepherdstown, WV
This five day class is based on two guides: *Climate-Smart Conservation: Putting Adaptation Principles into Practice and Considering Multiple Futures: Scenario Planning to Address Uncertainty in Natural Resource Conservation*. The first half of the course refers to the climate-smart conservation guidance and is designed to demystify climate adaptation for application to on-the-ground conservation. The second half of the course refers to the scenario planning guidance and introduces the core elements of scenario planning. Registration is limited, so don't delay in registering. For more information, click here.

October 18-21, Conference: Natural Areas Conference. UC Davis
The conference theme is "Climate Change Adaptation and Natural Areas Management: Turning Words to Action." The conference will focus on the nuts-and-bolts of climate change adaptation, with the target audience of those involved in natural areas management. Abstracts for oral and poster presentations are being accepted until May 2, 2016.

Recorded Webinar: How Identifying Climate Refugia can help to Prioritize conservation
This presentation summarizes the physical processes that create climate refugia, discusses a new framework for locating and managing them, and uses examples to illustrate ways to identify and verify climate refugia.

Recording now available: Planning for connectivity on national forests under the 2012 Planning Rule

Recordings now available: 2015 Northwest Climate Conference
These videos are also linked from the web version of the conference program: http://pnwclimateconference.org.

Adapting to Climate Change: A Short Course for Land Managers *(from Climate.gov)*
Information in this short course summarizes the state-of-the-art science for natural resource managers and decision makers regarding climate variability, change, projections, and ecological and management responses.

CLIMATE SCIENCE NEWS

Record annual increase of CO2 observed at Mauna Loa for 2015 *(from NOAA)*
The annual growth rate of atmospheric carbon dioxide measured at NOAA's Mauna Loa Observatory in Hawaii jumped by 3.05 parts per million during 2015, the largest year-to-year increase in 56 years of research. Learn more».

Winter was record warm for the contiguous U.S. *(from NOAA)*
A strong El Niño helped fuel a warm and wet winter for the United States. The average temperature for the contiguous U.S. during winter (December - February) was 4.6°F above the 20th century average, a new record, ccording to scientists from NOAA's National Centers for Environmental Information.
Learn more»

Twentieth century global sea level rise faster than past 27 centuries *(from NOAA)*
The 20th century saw the fastest rise in global sea level in 27 centuries, according to a new study supported by NOAA.
Learn more »

New Study Suggests West Antarctic Ice Sheet Could Melt Rapidly (*from Justin Gillis, New York Times)*
(from the article) "Continued high emissions of heat-trapping gases could launch a disintegration of the ice sheet within decades, according to a study published Wednesday, heaving enough water into the ocean to raise the sea level as much as three feet by the end of this century. With ice melting in other regions, too, the total rise of the sea could reach five or six feet by 2100, the researchers found. That is roughly twice the increase reported as a plausible worst-case scenario by a United Nations panel just three years ago, and so high it would likely provoke a profound crisis within the lifetimes of children being born today."

SPECIES AND HABITATS

Nearly all US forests threatened by drought, climate change *(from ScienceDaily.com)*
Forests across the United States are feeling the heat from increasing drought and climate change. While the effects have been most pronounced in the West, virtually all US forests are now experiencing some degree of change and are vulnerable to future declines. Drought-induced forest diebacks, bark beetle infestations and wildfires are already occurring on large scales across the West, and many models predict droughts are likely to become more severe, frequent and prolonged across much of the United States. There is also mounting evidence that climate is changing faster than tree populations can respond by migrating to new regions. "Given the high degree of uncertainty in our understanding of how forest species and stands adapt to rapid change, it's going to be difficult to anticipate the type of forests that will be here in 20 to 40 years." James S. Clark, et al. The impacts of increasing drought on forest dynamics, structure, and biodiversity in the United States. Global Change Biology, 2016; DOI: 10.1111/gcb.13160

Rained Out: Arctic Nesting Birds Struggle With Climate Change (*from Forbes/Science)*
As global warming disrupts local climate patterns around the world, even Arctic breeding birds are affected. But unlike tropical and subtropical birds, which are harmed by rising temperatures, Arctic birds are harmed by increasing rainfall.

Conserving Biodiversity: Practical Guidance about Climate Change Adaptation Approaches in Support of Landuse Planning *(attached)*
Excerpt from the abstract: **"**As species' geographic ranges and ecosystem functions are altered in response to climate change, there is a need to integrate biodiversity conservation approaches that promote natural adaptation into land use planning. We present a framework that synthesizes six promising spatially explicit adaptation approaches for conserving biodiversity. We provide guidance on implementing these adaptation approaches and include case studies that highlight how biodiversity conservation can be used in planning. We conclude with general guidance on choosing appropriate climate adaptation approaches to amend for conservation planning."

Climate Change Vulnerabilities and Adaptation Options for Forest Vegetation Management in the Northwestern USA *(attached)*

Excerpt from the abstract: **"**Recent vulnerability assessments, conducted in diverse regions in the northwestern United States, indicate that many commonalities exist with respect to projected vulnerabilities to climate change. . Science–management partnerships associated with recent assessments have identified an extensive list of adaptation options, including both strategies (general planning) and tactics (on-the-ground projects). Most of the options focus on increasing resilience to disturbances and on reducing current stressors to resource conditions. Adaptation options are generally similar across the biogeographically diverse region covered by assessments, suggesting that there may be a limit on the number of feasible responses to climate change.

Interior Department Releases Report Underscoring Impacts of Climate Change on Western Water Resources

Here's a link to the report: http://www.usbr.gov/climate/secure/docs/SECUREWaterReport.pdf

Increasing ocean acidity affects Alaska crabs' shells

New NOAA Fisheries studies are warning that the future of the Alaskan crab fishery is uncertain--unless the crabs can adapt to a more acidic ocean.
Learn more »

Colorado River Flows Reduced by Warmer Spring Temperatures

The Colorado River is a crucial water source for humans in seven western U.S. states and Mexico. However, rising temperatures due to climate change are threatening the river's flow of water. In a new study supported by the Southwest CSC, scientists at the University of Arizona, University of Nevada, and USGS have found that since the 1980s, temperature has had even a larger impact on the Colorado River than precipitation. Read More >>

California Department of Fish and Wildlife Monitors Effect of Severe Drought on Wildlife; Stream- and Wetland-Dependent Species Most at Risk

Amphibian, reptile, bird and mammal populations that depend on freshwater marsh, streamside habitat and wet meadows are struggling most to endure the drought that has gripped California for more than four years, according to a comprehensive assessment released by the California Department of Fish and Wildlife (CDFW). CDFW biologists ranked the vulnerability of the state's terrestrial species and gave top priority for additional monitoring and assistance to 48 species. The greatest concentrations of these high-risk populations are found in Southern California coastal, mountain and valley regions, the Sierra Nevada mountain range, the Mojave Desert, Central Valley and the southern Cascade mountain range. View the full report.

How to shelter mountain streams in a changing world: can cold waters protect native fish from the worst of climate change? *(from High Country News)*

This article describes efforts lead by Dan Isaak and other scientists at the USFS Rocky Mountain Research Station to map data on stream temperatures across the west. In 2011, they began creating an interactive map that shows historical stream temperatures and projections for the next 80 years. The map now covers Washington, Oregon, Idaho, Montana, Wyoming and Utah, and work on Colorado, New Mexico and Arizona will be underway soon. Altogether, the existing maps combine 150 million temperature recordings from 20,000 stream sites, collected by more than a hundred agencies and resource groups. Isaak has been using the maps to identify "refuges" where water will stay cold enough to support bull trout and other species. In 2015, he and four other biologists published a paper in the journal *Global Change Biology* introducing these refuges. Collectively, they call them the **Cold-Water Climate Shield.**

POLICY, MANAGEMENT, COMMUNICATION

Coastal Wetland Restoration Can Now Earn Carbon Credits Globally

A new methodology to encourage coastal restoration across the globe has been approved by the Verified Carbon Standard (VCS). The *Methodology for Tidal Wetland and Seagrass Restoration* (VM0033) is the first globally applicable greenhouse gas accounting methodology for coastal wetland restoration, and will allow salt marsh, seagrass, mangrove, and other tidal wetland restoration projects to earn carbon credits.

Green Eelgrass, Blue Carbon

MIT Sea Grant is working with several partners to conduct a study to better understand the role eelgrass ecosystems play in preparing for and mitigating the effects of climate change. Get the full story »

Communicating about Climate Change – an article about re-framing the debate *(from Vox.com)*

*From the article: "*The danger of climate change does not arouse much public passion, certainly nothing like what the facts would warrant. This drives climate campaigners crazy. Always has. So how to get people's attention? One strategy might be to talk about climate change differently — to "frame" it differently, in the current jargon."

Which seafood guzzles the most gas? (*from Science Magazine)*

Most of us don't think about fuel when we eat seafood. But diesel is the single largest expense for the fishing industry and its biggest source of greenhouse gases. Not all fish have the same carbon finprint, however, and a new study reveals which ones take the most fuel to catch.